



Investment Protection on Intel® Itanium® Architecture

Taking the Lead in Performance, Value and Choice

The leading performance and value of Itanium® 2-based platforms are attracting many early adopters to Itanium-based solutions for their high-end enterprise and technical computing applications. These customers also value the widespread industry support for Intel® Itanium® architecture, which is driving rapid innovation and will protect their investment with multi-vendor choice of platforms and software with increasing availability for many years to come.

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Executive Summary

The Intel® Itanium® architecture is raising the bar for performance and value for the high-end enterprise and technical computing environments. With the release of the Intel® Itanium® 2 processor, Intel estimates that Itanium®-based platforms now offer 50%¹ higher transaction processing performance than comparable platforms from Sun Microsystems.

Key benefits of the Itanium architecture lie in its inherent scalability, and in the large industry commitment to advancing and supporting Itanium-based solutions. A core advantage of Intel® architecture has been that it is based on industry-standard technologies that enable hundreds of companies to develop compatible hardware and software products. It is difficult for proprietary vendors to match the research and development efforts of hundreds of independent companies collaborating on a single open architecture.

This large community of vendors helps to ensure comprehensive product support and competitive pricing. It also provides flexibility for businesses that adopt Intel-based solutions, enabling them to choose from multiple vendors for products and services.

The price and performance advantages of Itanium 2-based platforms are introducing compelling new reasons for businesses and organizations to begin their migration to Itanium architecture. This paper discusses why such a migration makes good, long-term business sense. It also provides some useful insight into migration opportunities, by identifying application segments where Itanium architecture-based solutions already provide compelling advantages over current RISC-based alternatives.

1. Configuration: Intel® Itanium® 2 processor (1 GHz, 32 GB system memory) vs. Sun UltraSPARC® III (1.05 GHz, 32 GB system memory). Source: Performance comparison based on Intel estimate of Sun UltraSPARC® III processor vs. Intel's forecast of production performance for the Intel® Itanium® 2 processor using online transaction processing (OLTP) workload testing.

Building Out on Intel® Itanium® Architecture

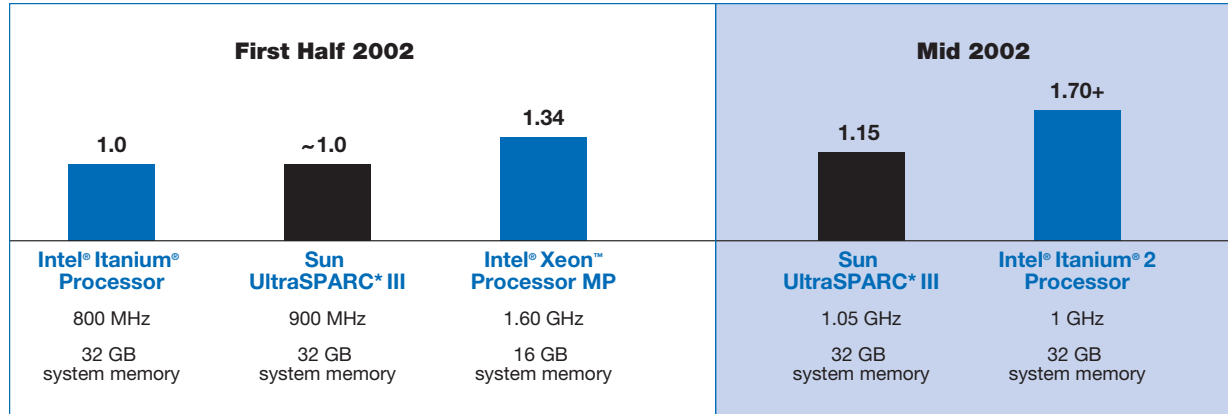
The Intel® Itanium® 2 processor, the second generation in the Intel® Itanium® processor family, has now been released, and will soon be available in a wide variety of platforms from leading server manufacturers. Intel estimates these platforms will deliver 50% higher transaction processing performance than comparable platforms from Sun Microsystems (Figure 1, next page). They will also be available at lower costs. Moreover, the Itanium 2 processor runs existing Itanium®-based applications 1.5 – 2 times faster than the first-generation Intel Itanium processor, without any need to recompile. Companies and organizations that do choose to recompile their code to take advantage of specific Itanium 2 processor enhancements can achieve even better performance².

Future Intel Itanium processors will continue to support binary compatibility with existing Itanium-based applications, to ensure that businesses and organizations can scale performance without recompiling applications. The Itanium 2 processor has also introduced a new era of hardware compatibility into the Itanium processor family. Those who deploy applications on Itanium 2-based platforms will be able to scale performance by upgrading to next-generation Itanium processors (code-named Madison and Montecito). This will help to ensure a long lifecycle for Itanium-based servers.

2. See the Intel white paper, "The Next-Generation Intel® Itanium® Processor," for detailed information about the superior performance of the Intel® Itanium® 2 processor (available on the Intel Web site at: www.intel.com/itanium2).

Enterprise Platforms Performance

4-way OLTP Performance¹



Driving choice, high performance, and value

1. Configuration: Intel® Itanium® 2 processor (1 GHz, 32 GB system memory) vs. Sun UltraSPARC® III (1.05 GHz, 32 GB system memory) Source: Intel estimates. Performance comparisons based on Intel estimate for Sun UltraSPARC® III processor and forecasted production performance for Intel® Itanium® 2 processor using online transaction processing (OLTP) workload testing at Intel.

Figure 1. Based on results in industry-standard benchmark tests, Intel estimates that Itanium® 2-based servers will provide 50% higher transaction processing performance than comparable platforms from Sun Microsystems.

Intel® Itanium® Processor Family Roadmap

	2001	2002	2003	2004
Back End Server High End Workstation • 8P Server / 2P Workstation	Intel® Itanium® Processor 4 MB Cache	Intel® Itanium® 2 Processor 3 MB Cache	Madison 6 MB Cache	Montecito
		Same system bus, chipset, form factor		
Mid-tier Server Performance Workstation • 2-4P Server / 2P Workstation	Intel Itanium Processor 2-4 MB Cache	Intel Itanium 2 Processor 1.5-3 MB Cache	Madison 3-6 MB Cache	Montecito
		Same system bus, chipset, form factor		

All dates specified are target dates, are provided for planning purposes only and are subject to change.

Figure 2. The Intel® Itanium® processor family roadmap emphasizes compatability from generation to generation to maximize investment.

Picking Up the Pace

One of the major reasons for adopting Intel® Itanium® 2 microarchitecture is that users will be able to scale their applications more quickly and affordably. The performance and compatibility of the Intel Itanium 2 processor – along with anticipated performance advances in follow-on processors – support this claim.

- **Industry-leading Performance:** The Intel® Itanium® architecture eclipses or challenges leading performance marks in a wide variety of high-end application categories. Moreover, it is delivering these performance advantages at far lower prices than are typical for proprietary RISC solutions.
- **Growing Industry Momentum:** Because of the open architecture and broad industry support for Itanium® architecture-based solutions, developers are moving steadily on all fronts (Figure 3, below). This support will continue to grow, expanding user options and providing a wide range of solutions from multiple vendors.

- **Maturing Solutions:** In addition to a breadth of Itanium® 2-based platforms, users can choose from multiple operating systems and an expanding list of applications.
- **Paving the Way with a Strong Processor Roadmap:** Ongoing processor enhancements will play a critical role in future advances. Development work on several new processor generations is well underway, and Intel is committed to delivering increasing performance and price/performance to fuel the rapid adoption of Itanium architecture-based solutions.

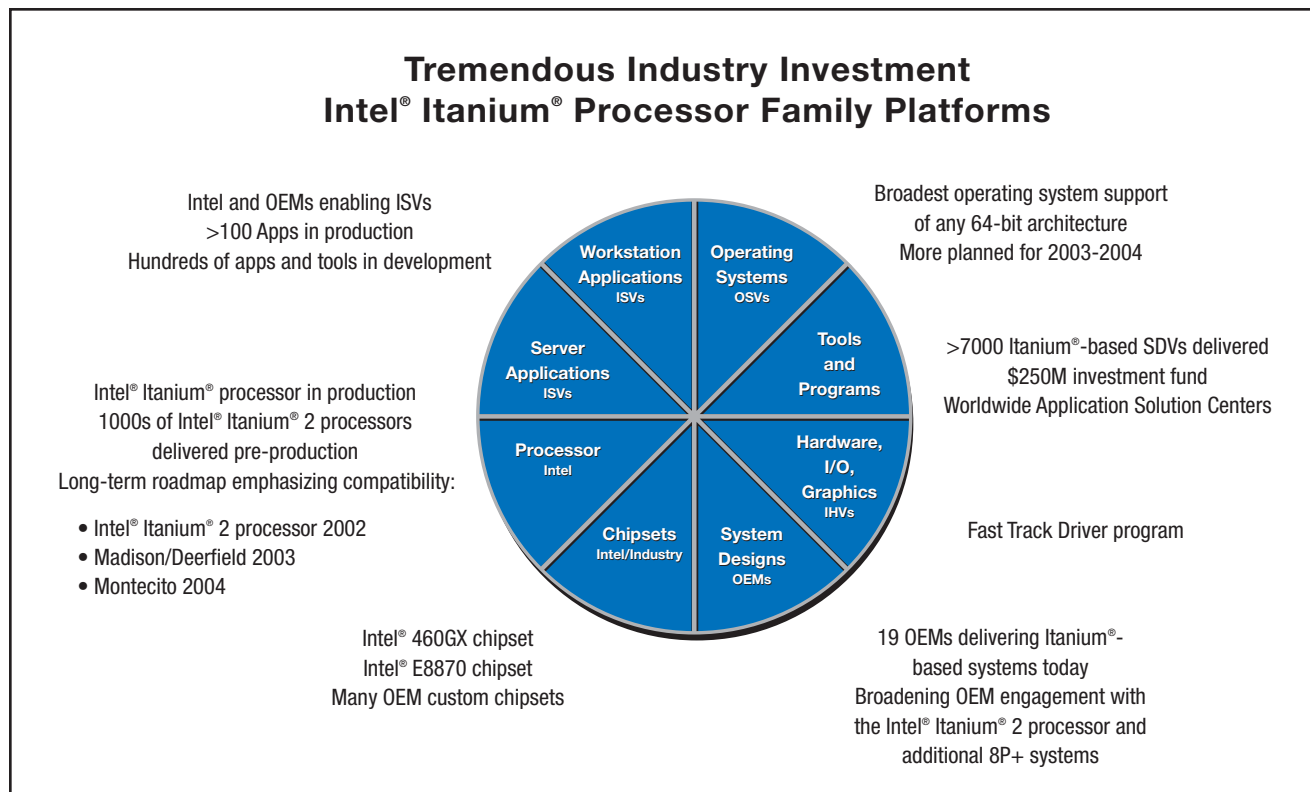


Figure 3. The release of the Intel® Itanium® 2 processor is adding to the industry momentum that is already driving the success of Intel® Itanium® architecture.

Volume Economics: A Bright Future for Intel® Itanium® Architecture

Intel® Itanium® architecture, which was designed from the ground up to address the needs of high-end computing, is based on Explicitly Parallel Instruction Computing (EPIC) technology.³ Just as important as the technology, however, is the business model that is being used to drive Itanium architecture into the marketplace.

Today's processors and chipsets incorporate hundreds of millions of gates and require highly sophisticated design, validation and manufacturing facilities. A high quality solution also demands the creation and ongoing enhancement of platforms, hardware components, operating systems, tools and application stacks. It takes enormous development efforts to keep pace with industry needs in all of these areas.

Itanium architecture is an open, standards-based architecture, which encourages collaborative development among a large and growing number of vendors. Unlike today's proprietary RISC-based vendors, Intel's business model is not based on proprietary solutions, but on wide collaboration and high-volume manufacturing, which simultaneously drive technology innovation and competitive pricing.

The success of this model has been demonstrated convincingly with Intel's 32-bit architecture, which now accounts for approximately 90% of all deployed systems in the entry-level to mid-range server market segments.⁴ With Itanium architecture, Intel has introduced this same approach into the high-end computing market. The basic business model is based on four simple principles.

- 1. Open Architecture:** Intel's open architecture is based on widely accepted industry standards that make it easier for independent companies to develop compatible hardware and software solutions. As a result, a large community of developers is drawn to the platform.
- 2. Competition and Collaboration:** The large community of developers accelerates platform advancement, and also ensures competitive pricing.

3. Innovation: Massive collaboration and competition drive a high level of innovation, which Intel encourages through advanced research and the development of industry standard building blocks.

4. Value: In the Intel business model, open architecture, competition, collaboration, and innovation converge to maximize the total value of the platform. Customers get more and better options at lower prices.

The success of this business model is derived from the positive feedback loop that fuels constant improvement. As value goes up, sales volumes rise. This causes more companies to join the community of compatible vendors, and enables existing companies to increase their research and development spending. Innovation, competition and value climb accordingly.

Customers are the ultimate beneficiaries of this open business model, which increases the quality and value of their options. With open standards and wide compatibility, they can take advantage of best-of-breed solutions. With a much broader vendor base, they will also find they have more companies tailoring products and services to match their specific business requirements. The large number of vendors also helps to reduce their long-term risk, since they are no longer dependent on a single company for business-critical solutions. If a vendor fails or disappoints, there are many compatible alternatives to choose from.

In the simplest terms, Intel's open architecture and high volume business model establish an environment in which hundreds of companies can work together to promote the value of the platform. Intel focuses on processors, chipsets and other core platform components. Other companies focus on compatible chipsets, supplementary hardware devices, platform development, operating systems, applications and support services. Altogether, this community of developers drives an unparalleled level of innovation. In an environment as unpredictable as the computer industry, customers will find no better guarantee of long-term value.

3. See the Intel white paper, "EPIC Technology Moves Forward," for detailed information about the superior scalability of Intel® Itanium® architecture (available on the Intel Web site at: www.intel.com/itanium2).

4. Source: IDC Q4, '01 Server Tracker.

Migration to Intel® Itanium® Architecture

While the advantages and reach of the Intel® Itanium® architecture will continue to grow over time, many businesses and organizations are deriving immediate benefits in solutions in the following application categories:

- High Performance Computing (HPC)
- Databases
- Mechanical Computer Aided Engineering (MCAE), Electronic Design Automation (EDA), Compute Intensive Custom Applications (Financial, Petroleum, others)
- Enterprise Resource Planning (ERP) and Supply Chain Management (SCM)
- Business Intelligence
- Security Transactions

Businesses and organizations that develop or deploy applications in these areas need robust solutions, and are turning to Itanium architecture because of its unique combination of performance and value. The absolute performance advantages of the Intel Itanium processor family, particularly for high-accuracy floating-point calculations, have made it a natural for the voracious computing needs of advanced scientific and engineering research teams. A prime example is the supercomputer now under development by the National Science Foundation, which will include both Intel Itanium processors and Intel® Itanium® 2 processors, with a combined total of over 3,300 processors in four separate facilities; all linked via high-speed interconnects. This distributed system will be capable of 13.6 trillion calculations per second, and able to work with 450 terabytes of data.

Another example is the supercomputer being developed for the Department of Energy's Pacific Northwest National Laboratory (PNNL). With 1,400 Intel Itanium 2 processors, this system will be able to perform up to 8.3 trillion floating point operations per second, and will be one of the world's most powerful Linux-based supercomputers.

The deployment of Itanium® architecture-based solutions is also increasing in the private sector. Early adopters in the segments listed above are taking advantage of Itanium architecture to gain a competitive edge through better performance and lower costs. Over the next year, the results of many of these implementations will be made available to the public. The combination of successful

implementations, increasingly mature software solutions, and continuing processor and platform enhancements will provide compelling incentives for mainstream users to migrate to Itanium architecture-based solutions. As a result, industry momentum will continue to accelerate.

Conclusion

The Intel® Itanium® architecture is bringing the advantages of volume economics into the high-end computing environment. The platform release of the Intel® Itanium® 2 processor will increase industry momentum for Itanium architecture by establishing a clear lead in both performance and value in comparison with competing RISC-based platforms.

Itanium architecture is an open, standards-based architecture, which encourages collaborative development among a large and growing number of vendors. Unlike today's proprietary RISC-based vendors, Intel's business model is not based on proprietary solutions but on wide collaboration and high-volume manufacturing. Combined with Intel's strong processor roadmap, this collaborative environment drives continuous technology innovation and competitive pricing.

A wide variety of early adopters have already deployed, or are now deploying, Itanium®-based solutions. Over the next year, the success of these implementations will drive increasing interest in the mainstream marketplace. Solutions will also continue to mature, providing better and more comprehensive off-the-shelf applications.

Most importantly, the community of Itanium processor-compatible vendors continues to grow. This large community of vendors enhances customer flexibility and also helps to reduce long-term risk, since end users are no longer dependent on a single company for business-critical solutions. If a vendor fails or disappoints, there are many compatible alternatives to choose from.

We encourage you to explore the potential for Itanium-based solutions in your own computing environment. Check with your hardware, software and solution providers to learn about their support for Intel Itanium architecture. Or visit us on the Web at: <http://www.intel.com/eBusiness/products/itanium> or <http://www.intel.com/itanium2>

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The Intel® Itanium® processor and the Intel® Itanium® 2 processor may contain design defects or errors known as errata, which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Designers must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined." Intel reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them.



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